Production of Liquid Carbon dioxide from 2 TPH of Raw gas

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A. Introduction

Liquid carbon dioxide is the liquid state of carbon dioxide. It is a transparent and odorless liquid. It is a type of liquid which is formed from highly compressed and cooled gaseous carbon dioxide. It is used in softening drinks, refrigeration and freezing in food processing, shield gas in welding, fire suppression systems, enhanced oil recovery of oil and gas wells, etc. The present work focuses on production of liquid carbon dioxide from raw gas. This flow sheet is developed as part of the final semester project work.

B. Process Flow Sheet Description

The process involves the production of liquid carbon dioxide from raw gas. The raw gas has seven components other than carbon dioxide. The gas is first sent to a raw gas cooler to cool the inlet gas. The gas is then compressed and cooled to get the operating temperature of the flash column. In the first flash column, water and methanol are removed in the liquid stream while carbon dioxide is recovered with other components in vapor stream. In the second flash column, carbon dioxide is recovered in liquid stream along with ethanol, dimethyl sulfide and acetaldehyde.

C. Results

The entire process flow diagram for production of liquid carbon dioxide is simulated in DWSIM (v5.8).Raw gas composition is taken from available industrial data. Peng-Robinson (PR) is used as the thermodynamic model to incorporate variation from ideal behavior of the raw gas feed. Shell and tube heat exchanger is simulated with ammonia as the refrigerant for the raw gas cooler. Ammonia is sent in shell side and raw gas is sent in tube side. The inlet conditions for the ammonia and design variables are taken from the available industrial raw gas cooler data. A vapor-liquid separator (B10) is used after the raw gas cooler to separate the liquid in the stream before compression.

Two adiabatic compressors with efficiency of 75% and two coolers with efficiency of 100% are used before the two flash columns. Another vapor-liquid separator (B9) is used after first flash column because the vapor outlet (S5) from flash column (B5) had mixture of vapor and liquid which is a bug in DWSIM. Liquid carbon dioxide is obtained with 99.89% purity in stream (S8). The overall liquefaction efficiency is 62.66 %.

Unit System (SI_1 in DWSIM)

Temperature - ^{o}C

Pressure - bar

Mass Flow Rate - kg/h

Molar Flow Rate - kmol/h

Volumetric Flow Rate - m^3/s